

Non-Inverting Amplifier With Offset and Gain Adjust

In this project, you will make an amplifier with adjustable offset and gain. Gain refers to the amount of amplification; the offset is a constant added to the signal. The amplifier will be implemented with an *operational amplifier* (op-amp), a very common and useful device. You will also learn the basics of using an oscilloscope to test your circuit.

Equipment

- Cadet Board
- 741 Op-amp
- Resistors, one each of: 30, 62, 91, and 220 Ohms
- oscilloscope
- voltmeter
- wires

Procedure

Op-amps are very useful devices. The name comes from the fact that they used to be used to implement mathematical operations in analog computers. A common op-amp is the 741. There are various markings for it; in the NDSU labs it can usually be found under LM741. The op-amp will be in a Dual Inline Package (DIP). The first pin is labeled with a small dot.

Op-amps have one or two power supply terminals, usually called the *rails*. If there are two rails (741 has two), they are usually equal in magnitude and opposite in sign. For this project, the rails will be the variable voltage supplies on the Cadet (V+ and V-). Set the variable voltages to +10V and -10V, using the voltmeter.

Turn on the oscilloscope and try viewing the Cadet's on board signal generator. Connect the alligator clip of the probe to ground and the tip of the probe to the signal generator on the left side. Don't use the TTL part, as this will only give a square wave. Push the Auto Scale button of the scope to bring the signal into view. Try varying the waveform type, amplitude, and frequency. Change the voltage scale and time scale of the scope. Try moving the trigger level, which sets the voltage at which the scope measures the waveform. When the input signal rises above the trigger level, the scope captures the signal. You may have to play with this later to display your signal correctly.

Make sure to turn off the Cadet board's power before building your circuit. Build the circuit according to the diagram. Use the on board signal generator for the V_{in} voltage. The signal generator is already grounded internally, so you only have to connect the one terminal to your circuit.

Use the potentiometers at the bottom of the board to make the variable resistors. The far left and far right columns of holes for the potentiometers correspond to the opposite ends of the resistor in the diagram. The two middle columns of holes for the potentiometers correspond to the arrow in the diagram. The resistance across the ends of a potentiometer is constant (10k and 1k Ohms in this case), and the resistance between one end and the middle is variable between zero and the value of the potentiometer.

When the circuit is built, turn on the Cadet power. You will have to turn the amplitude of the signal generator down to around a quarter of the maximum to get undistorted output. Connect one oscilloscope probe to the input (the signal generator) and the other probe to the output. Auto scale the

scope and adjust the offsets and scales to fit the signals to your liking. Play with the offset (10k potentiometer) and the gain adjust (1k potentiometer), and the parameters of the signal generator. Try to figure out why the the output gets clipped when the input is too large. Try varying the frequency over a very wide range. Try increasing the frequency above 20 kHz.

When you have your implementation tested and checked off, put everything away in the correct bins and leave the lab better than you found it.

